SCIENCE, TECHNOLOGY AND NATIONAL POWER

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ABSTRACT

The United States faces three serious technological challenges from the rest of the world: a military technology challenge from the Soviet Union, a civilian market challenge from the Free World, and an "image" challenge in electronics and aerospace from both. These challenges impact on our national security either directly in military equipment prototypes or indirectly by the erosion of our production and tax base. They are direct challenges to our future as a world leader. Our response to such challenges is therefore investment in our own future. But many of the present trends are not to our advantage.

INTRODUCTION

National power might be defined as internal strength and the ability to project one's influence externally when and as needed. Two of the strongest elements of national power are economic and military strength. Science and technology affect both. By almost any standard, the United States is the richest, most powerful and most technologically advanced country in the world today. We face difficult external

and internal challenges, but few countries in the world wouldn't trade their problems for ours.

It is a truism that both our economic and military position is to a considerable degree the result of our development and exploitation of technology. However, beginning in about the mid-1960's, our efforts in this direction began to slack off.

Meanwhile, the rest of the world has driven onward and upward. The Soviet Union apparently senses a real chance finally to surpass the United States in military power and technology. Japan and Europe are increasing their share of the international market at an accelerating rate. The image of world technical leadership earned by our electronics and aerospace industries in the 1960's will predictably be eroded in the 1970's by our own lack of planned "firsts" in contrast with the continuing achievements of the Soviet Union, France, and probably Germany and Japan.

Like it or not, we are in a stiff international competition. When you think about it, we have been doing unbelievably well: with only 7% of the world's population we are on the top of the mountain. But there is nothing which gives us the inalienable right to stay there, to relax, to let the money flow in from some inexhaustible source, and

to worry only about how to plan our leisure time. On the contrary, it turns out that our major source of wealth in the future must be the special skills of our population -- and yet we are presently pricing ourselves out of the world markets, including our own. We are also disseminating our science, our inventions, our management expertise, and our manufacturing technologies around the world in a way which, though it raises the standards of living elsewhere, also diminishes the competitive advantages of our own people.

To put it succinctly, many Americans have been acting as though we have it made. Too many of us seem to forget that we were not always on top of the mountain; as a matter of fact, we have been there less than 25 years, and part of our advantage stemmed from the fact that the rest of the world 25 years ago was flat on its back following World War II. And yet, one can hear discussions of the reordering of national priorities as if we could make unilateral decisions independent of the international competition -- as if international interactions were not a significant, much less a driving, factor. And this is true whether the discussion subject happens to be defense R&D, the NASA space program, tax incentives to industry, or a wage/price freeze.

Such discussions are all too easy -- and all too short-sighted. But perhaps it is in the nature of professional technologists to be especially sensitive to such things because, always thinking in terms of the future, the technologist is often the first to see the new challenges.

THE CHALLENGE IN MILITARY TECHNOLOGY BY THE SOVIET UNION

The most direct challenge to US national power and national security is the military challenge by the Soviet Union. Most of us are familiar with the force level comparisons of our strategic and tactical forces with those of the Soviet Union and how they have changed with time. Because of these changes, one seldom hears the words "clear superiority" in describing US forces today. On the other hand, our forces do represent a very realistic deterrent today -- no country, including the Soviet Union, wants to risk a direct military confrontation with us as of now.

In military technology we are ahead, on the average, by about 2 years with some of our systems being further ahead than that by a few years and some being behind. More precisely, our pre-production prototypes have been starting their conspicuous testing phase about two years ahead of comparable Soviet systems, on the average. This

technological lead is of considerable advantage to us in minimizing the dangers of a technological surprise, in understanding the significance of a Soviet system when it first appears in the open, in offsetting the assymmetry in the secrecy levels of the two countries, and of insuring us the option if it becomes necessary, to produce equipments in quantity, and in time.

We have had this technological lead for at least a decade. However, we have not been able to increase it significantly despite major advances in the state of the art because the Soviets advanced also. Their advances, like ours, were the result of considerable effort, which evidently approximated ours during the 1960's. But since about 1967-8 the Soviets apparently have increased the pace of their military R&D relative to ours at the rate of at least 10% per year. It could be argued that the Soviets couldn't keep up the 10% per year rate of increase. The counter argument is that such rates of increase have been shown to be not only possible but healthy as well. With a Soviet GNP increasing at about 8% to 10% per year, the Soviets can "afford" this investment in their military future. If, as our best estimates indicate, their efforts and ours were approximately equal before 1967-8, theirs would now be 30-50% greater than ours.

Presumably such increased effort should yield increased results. What then are the kind of results we should expect from the larger Soviet military R&D effort? Primarily we should expect more efforts at exploiting science and technology for military purposes, more investments in better R&D facilities from computers to test ranges, and more weapon prototypes. We might expect most Soviet projects to be justified by their impact on overcoming specific US technological advantages over the Soviet Union. For example, we have been saying that we are going to have smaller and better tactical military forces. But our technological lead in tactical systems is minimal and, were I a Soviet R&D planner, with a larger available R&D investment to make, I certainly needn't let the US extend its slim lead and I might even negate it. A Soviet R&D planner would also address the problems of finding the US nuclear missile submarines, of defending against our strategic bombers and of neutralizing land-based ICBM's as well as improving the Soviet's own offensive weapons. Indeed, individuals in the Soviet high command have said as much in open speeches. If there is any hesitation in the Soviet Union about improving the Soviet forces, it hasn't been apparent for many years.

To be specific, if present investment trends continue, we would have smaller but better equipped forces than we do now, but they won't necessarily be qualitatively better than the Soviets'. They could be clearly inferior. The relative qualitative position depends strongly on the preceding R&D investment in technology. Technology in the 1970's should offer, to whomever invests in it

* A very good possibility of markedly improved night operations by large numbers of mechanized elements.
* Much better control of the air space immediately over a battlefield using surface firepower or air elements or both in concert.
* Much better control of firepower with reduced collateral damage.
* Notably increased small unit effectiveness in a fluid battle situation.
* Greatly improved intelligence on enemy movements through use of sensors.

In order to exercise such technological options, it will be necessary to reduce the costs of logistics, maintenance, and operations -- the "people costs" and the "spare costs." We are in a severe cost squeeze. The increasing per unit costs of the more modern equipment don't help the situation, though one might

be willing to trade higher per unit capital costs if the life cycle costs were reduced. Our defense will cost money and money is limited.

The problem of money leads to the next challenge, the Free World challenge in the civilian world market.

THE CIVILIAN-MARKET CHALLENGE FROM THE FREE WORLD

The Defense Budget is part of the larger Federal Budget where it must compete with other national needs. At the moment, these other needs are in the majority, if not the ascendancy, in use of the Federal Budget. The Federal Budget is not an inexhaustible source but is instead produced by our taxation of ourselves. To pay taxes we must earn money by producing something someone else wants at a competitive price. In simple terms, it is our work which produces taxable wealth.

We in the United States have one of the highest standards of living in the world which means some of the highest wage and salary levels. We have achieved this by exceptionally high productivity per worker.

Now let us see how these facts apply in the international market place, remembering that a great deal of the international market is right here in the US.

If we buy an American product, Americans work, which means they produce wealth, pay taxes, and buy still more things. If we buy a foreign product, one just as good but at a lower cost, we get more for our money, but the foreigners make the wealth and pay taxes to their governments instead of ours. In the past, this argument has been used to restrict trade and to "protect" local industry -- and to some extent this still occurs. But we have also begun to recognize a distinction between high technology products and low technology products in their effects on our economy. High technology products include electronics, aerospace, automobiles, and some agricultural products -- all items where the individual worker produces high value per man hour. Low technology includes footware, textiles, iron, steel and furniture -- items of low productivity or old, widely available technology.

Our recent economic history has shown that we have achieved much of our standard of living by high productivity in high technology products while importing low technology products and decreasing our production of them. Under these conditions, international trade and free markets have proved very worthwhile to us as a nation. A key strategy would seem to be to produce and export high technology and to import low cost, low technology, products; barriers to this strategy hurt us.

This lesson has not been lost on other countries, particularly the European community and Japan, and that is where the challenge to us has arisen. These countries are investing very heavily in high technology industries, converting their present industries to greater productivity, taking advantage of their lower wage rates (often importing foreign labor to keep the rates low) and moving in on the international market in just the areas where the US was producing best.

The other countries very well understand the importance of investing in their own future, and what it takes to equal or surpass the United States. Whereas we invest about 1.5% of our GNP on industrial R&D, the Japanese are investing 2% and the Germans 2.6%. If we add the capitalized value of purchased technology (largely from the United States), the effective Japanese R&D investment percentage of GNP is about twice ours and the German, more than twice. Whereas we invest about 11% of our GNP in fixed assets (new plants and equipment), the Germans are investing 19% and the Japanese an almost unbelievable 30%. Our vaunted productivity (the output per man-hour in manufacturing) which in 1960 led the world, is now less than that of Japan by 40% and less than that of the United Kingdom, Canada, West Germany, and France, in ascending order.

Compounding the problem, labor costs in manufacturing in both Europe and Japan are less than half ours. As an index of relative inventiveness, in applications to our Patent Office, almost half of the applications are now from foreign sources; as recently as 1960 that ratio was only 25%.

In addition, some countries, such as Japan, have set up barriers to enhance their own desires for a high-out, low-in, export/import situation by excluding our high technology products from their internal markets. US computers, for example, are being steadily excluded from the Japanese markets while the Japanese concentrate on raising their own computer technology for export elsewhere.

The Japanese investment/export policies have paid off handsomely. Their share of the world market has gone from 1% in 1950 to 6% in 1970. The European Economic Community has also done well, increasing their share from 15% in 1950 to 20% in 1970. Fifty per cent of the growth is in manufactured products. A considerable amount of the growth is in automotive products and telecommunications -- high technology areas in which our imports now exceed our exports by hundreds of millions of dollars annually.

If [illegible] like a list of foreign products we are all beginning to see in our markets, don't be surprised:

* Aircraft and parts
* Motor vehicles and parts
* Telecommunications apparatus
* Metalworking machinery
* Electronic computers
* Instruments and controls
* Agricultural machinery and parts

We still have the lion's share of the international civilian market. The problem is that the trends are against us. These trends are exacerbated by our internal needs for Federal funds to be expended in low technology efforts at the expense of such high technology efforts as space technology, defense products, scientific research and "big science" projects. Tax incentives for modernization and industrial research, minimal here in the interests of present tax revenues, have contrasted sharply with foreign incentives. Our steady drift toward more personal services and other low technology fields of work and away from engineering and manufacturing also contribute to the problem. The effect on our economy of unemployment of some of our most skilled scientists and engineers is beginning to be felt; underemployment and retraining into less skilled jobs is equivalent to reduction in the productivity of the country as a whole. Meanwhile, in the countries that are challenging us,

employment is at record highs, the tax base is excellent, the import situation is excellent, and the currencies are increasing in value relative to the dollar.

The civilian market challenge is therefore very real. It helps explain why, even if the Soviet military challenge appeared to increase, future US defense expenditures are unlikely to rise markedly -- the tax base is limited and its expansion faces serious challenge.

THE IMAGE CHALLENGE IN ELECTRONICS AND AEROSPACE

But, as stated earlier, by almost any standard the United States is the richest, most powerful, and most technologically advanced country in the world today. No small part of this is because we have the image of being the richest, most powerful, and most technologically advanced.

There is a tendency to forget the importance of world image until the image is in trouble. The Soviet Sputnik gave us image trouble. We responded with Apollo. We are now beginning to have image troubles with our commercial products as other countries successfully produce "space age" televisions, instruments, and materials that are often better than our products. Now it is some

of our products, on our own markets, that are regarded by the public as less desirable and are regarded by our own industries as non-profitable to the point where they buy foreign products and put US labels on them.

Image is the product of many things, some of them apparently irrational to most of us but all too familiar to those in public affairs. Apollo, to its real credit, incorporated public affairs elements in its design, specifically the now-famous live TV from the moon. In the early days of the Apollo program, live TV was fought by some people in the project on the grounds that it was a "public affairs gimmick," of no scientific value, and of little operational use. As we have all observed, however, it made the project come alive for its sponsors, the American people, and for the world audience.

A projection into the 1970's would seem to show that our image in the world is likely to be hurt, and our competitive position industrially and politically as well, by the fade-away of our space program, the cancellation of the SST project, the rejection of imaginative radio astronomy projects, our hesitation in exploring the oceans, and our anti-technology diatribes just when our competitors are driving ahead in these areas. And this is strange, because we were the ones who used such efforts in the past to help stimulate

ourselves and our economy, to create our high standard of living while simultaneously providing much of the free world's total security.

ACTIONS TO MEET THE CHALLENGES

It is to the considerable credit of our Government that these challenges are not only seen but that actions are either proposed or underway to do something about them.

* The international market challenge description given above was largely taken from the Statement of the Secretary of Commerce to the Congress of July 27, 1971. The proposed corrective actions are, in part, given in the President's message to the American people of August 15th.
* The defense R&D challenge has been extensively discussed with the Congress by the Director of Defense Research and Engineering and by both the Secretary and Deputy Secretary of Defense. Leaders of our Armed Services have indicated their concern over the Soviet R&D challenge by recommending increased R&D even at the expense of reduced force levels. Regardless of possible increases in the total RDT&E budget, DOD must make its defense R&D process more efficient. DOD is making improvements in management, especially

in weapons system acquisition and in training and career patterns for officers engaged in it. Harder choices in weapons systems developments must be made, including cost-enforced commonality, increased interest in allied weapons developments, and more specific response to Soviet developments than in the past. DOD is digging in to the problem of simultaneously increasing the front line combat capability while reducing the long logistics tail and other manpower costs -- one probable approach is to significantly improve the maintainability and reliability of our equipments. DOD is probably going to have to turn away from the extremely high performance weapons systems with per unit costs so high that insufficient numbers can be procured to be effective as a fighting force.

* The image problem, for better or worse, has had to take a back seat to more pressing problems.

CONCLUSION

Science and technology contribute strongly to national power -- to a country's military strength, to its wealth, and to its image to itself and others. The biggest contributions are to future national

strength and therein lies both danger and promise. In today's rapidly changing technologies, the future will belong to those who invest in it today.

The following charts supplement the paper. Information on the charts comes from NSF, the intelligence community, the Department of Commerce, and the Department of Defense. Due to the difficulties in converting each country's apparent R&D expenditures in its own currency into equivalent US effort expressed in US dollars, the charts should be used with some caution. Trends are generally correct: absolute magnitudes may be in error by a few tens of percent. Not included in the civil R&D expenditures for Western Europe and Japan is the equivalent value of R&D to those countries from purchase of US licenses to produce. Some economists estimate that this equivalent value increases the effective civil R&D of those countries by from 20% to 50%